IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

LG DISPLAY CO., LTD., Plaintiff, v. AU OPTRONICS CORPORATION; AU OPTRONICS CORPORATION AMERICA; CHI, MEI OPTOELECTRONICS CORPORATION; and CHI MEI OPTOELECTRONICS USA, INC., Defendants.	C.A. No. 06-726-JJF **CONSOLIDATED CASES**
AU OPTRONICS CORPORATION, Plaintiff, v. LG DISPLAY CO., LTD. and LG DISPLAY AMERICA, INC., Defendants.	C.A. No. 07-357-JJF

SECOND DECLARATION OF HUA CHEN IN SUPPORT OF AUO'S RESPONSIVE CLAIM CONSTRUCTION BRIEF FOR LG DISPLAY'S PATENTS

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September 4, 2008

I, Hua Chen, declare as follows:

1. I am an attorney duly admitted to practice before all the courts of the State of California, and also admitted to practice pro hac vice before this Court. I am an attorney with the law firm of Paul, Hastings, Janofsky & Walker LLP, counsel of record for Defendants Au Optronics Corporation and Au Optronics Corporation America (collectively "AUO"). I have personal knowledge of the facts declared herein, and if called as a witness, could and would competently testify thereto.

2. I make this Declaration in support of AUO's Responsive Claim Construction Brief for LG Display's Patents.

3. Attached hereto as Exhibit "1" is a true and correct copy of selected portions from LG. Philips LCD Co., Ltd.'s Opening Claim Construction Brief filed on or about February 6, 2004. The opening brief was filed in connection with a consolidated action in the U.S. District Court for the Central District of California styled *LG. Philips LCD Co., Ltd. v. Tatung of Am., Tatung Co., and Chunghwa Picture Tubes, Ltd.*.

4. Attached hereto as Exhibit "2" is a true and correct copy of selected pages from the RANDOM HOUSE WEBSTER'S COLLEGE DICTIONARY (1991).

5. Attached hereto as Exhibit "3" is a true and correct copy of U.S. Patent No. 5,410,423, issued to Furushima et al. on April 25, 1995.

6. Attached hereto as Exhibit "4" is a true and correct copy of selected pages from THE AMERICAN HERITAGE DICTIONARY (3rd Ed. 1994).

I hereby declare under penalty of perjury under the laws of the United States of America that the matters declared herein are true and correct, and that this declaration is executed this 4th day of September, 2008, at Los Angeles, California.

By _____
Hua Chen

CERTIFICATE OF SERVICE

I, Karen L. Pascale, Esquire, hereby certify that on September 4, 2008, I caused to be electronically filed a true and correct copy of the foregoing document with the Clerk of the Court using CM/ECF, which will send notification that such filing is available for viewing and downloading to the following counsel of record:

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I further certify that I caused a copy of the foregoing document to be served by e-mail on the above-listed counsel of record and on the following non-registered participants in the manner indicated:

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UNITED STATES DISTRICT COURT

CENTRAL DISTRICT OF CALIFORNIA

LG.PHILIPS LCD CO., LTD.,

Plaintiff,

vs.

TATUNG CO. OF AMERICA, TATUNG COMPANY AND CHUNGHWA PICTURE TUBES, LTD.,

Defendants.

LG.PHILIPS LCD CO., LTD.,

Plaintiff,

vs.

JEAN COMPANY LTD.,

Defendant.

Case No. CV 02-6775 CBM
Case No. CV 03-2866 CBM
Case No. CV 03-2884 CBM
Case No. CV 03-2885 CBM
Case No. CV 03-2886 CBM

LG.PHILIPS LCD CO., LTD.'S OPENING CLAIM CONSTRUCTION BRIEF

DATE: April 5, 2004
TIME: 3:00 PM
PLACE: Courtroom of the Honorable Consuelo B. Marshall

LG.PHILIPS LCD CO., LTD.,

Plaintiff,

vs.

LITE-ON TECHNOLOGY CORP. and LITE-ON TECHNOLOGY INTERNATIONAL INC.,

Defendants.

LG.PHILIPS LCD CO., LTD.,

Plaintiff,

vs.

TPV TECHNOLOGY, LTD, and ENVISION PERIPHERALS, INC.,

Defendants.

LG.PHILIPS LCD CO., LTD.,

Plaintiff,

vs.

VIEWSONIC CORP.,

Defendant.

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I. INTRODUCTION

LG.Philips LCD Co., Ltd. ("LPL") has sued Chunghwa Picture Tubes, Ltd. ("CPT"), Tatung Co. and Tatung Company of America (collectively, "Tatung"), Jean Co., Ltd. ("Jean"), Lite-On Technology Corp. and Lite-On Technology International Inc. (collectively, "Lite-On"), TPV Technology, Ltd. and Envision Peripherals, Inc. (collectively, "TPV"), and ViewSonic Corporation ("ViewSonic") (all collectively "Defendants") for patent infringement. Following the parties' Second Revised Joint Claim Construction Statement (hereinafter "JCC"), this is LPL's brief in support of its claim constructions.

The patents at issue relate to liquid crystal display ("LCD") devices, which are ubiquitous today in the form of displays in laptop computers, LCD monitors, LCD TVs, and other consumer and commercial products. LPL's patents fall into two categories. Four of the patents relate to a particularly advantageous way of mounting an LCD device in a laptop computer or stand-alone LCD unit (*e.g.*, an LCD monitor) by using the sides of the LCD device so that the front, viewing surface of the LCD device is maximized. For convenience, this first group of patents, U.S. Patent Nos. 6,373,537 ('537 patent); 6,002,457 ('457 patent); 6,020,942 ('942 patent); and 5,926,237 ('237 patent), will be referred to as the "side-mounting patents." The other two patents, U.S. Patent Nos. 4,624,737 ('737 patent) and 5,825,449 ('449 patent), relate to the semiconductor structures used in LCD devices and their formation and are referred to as "the semiconductor patents."

Copies of the asserted patents can be found in LG.Philips LCD Co., Ltd.'s Exhibits to the Revised Joint Claim Construction Statement at 2-56 (side mounting patents); 374-83 ('733 patent); and 374-83 ('449 patent). This collection of exhibits will be cited hereinafter as "LPL Exs. at __."

II. LAW OF CLAIM CONSTRUCTION

"It is well-settled that in interpreting an asserted claim, the court should first

figure). *Id.* The gate pads 630 and source or data pads 640 receive electrical signals from external driving circuitry. *Id.* (1:27-30). *See also* Figure 8 of U.S. Pat. No. 4,331,758 ("the '758 patent") (at LPL Exs. 313) (illustrating a portion of such an array).

In operation, by electrically addressing any given row and any given column, a single transistor of the array can be turned on, thereby permitting current to flow from its source through the conductive channel of the semiconductive material to the corresponding drain where said current builds a voltage on its associated pixel electrode. LPL Exs. at 317 ('758 patent at 7:58-8:5); *id.* at 380 ('449 patent at 1:67-2:2). As previously noted, the resultant voltage on the pixel electrode will produce an electric field across the liquid crystal that controls how bright or how dark the particular pixel of the LCD appears. *Id.* at 317 ('758 patent at 8:5-9); *id.* at 380 ('449 patent at 2:2-4).

B. '737 Patent Claims

The '737 patent discloses and claims a process for producing a TFT which, among other things, improves electrical contact between the various layers that make up the TFT while reducing the number of steps required to complete the device. LPL Exs. at 309 ('737 patent at 1:47-58). LPL asserts only claim 1 of the '737 patent against Defendants, and therefore, only terms within claim 1 are disputed. To illustrate the process recited in claim 1, LPL presents the following figure which correlates the steps and structures recited in the claim with corresponding elements of Figure 3 of the '737 patent describing one embodiment of the claimed invention.

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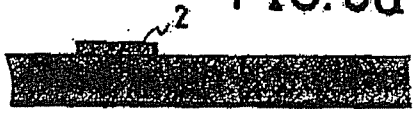
Claim 1 and Fig. 3 of '737 Patent

A process for producing a thin-film transistor comprising

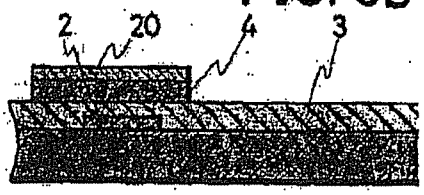
FIG. 3a



a first step for forming a [redacted] on an [redacted],

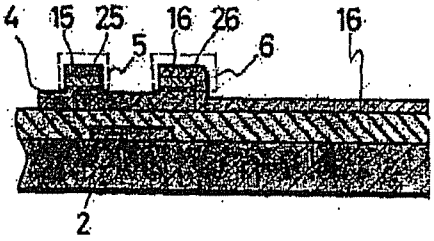
a second step for continuously depositing on said [redacted] and [redacted] a gate insulating film, a [redacted] and a conducting film containing at least a low-resistivity semiconducting film without exposing them to an oxidizing atmosphere, a third step in which said high-resistivity semiconductor film and said [redacted] are etched so that they are partly left as an island region on said [redacted],

FIG. 3b



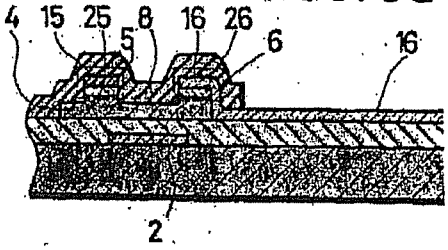
a fourth step for selectively forming a [redacted] and a [redacted] both contacting a part of the surface of said island region and spaced apart from each other, a fifth step for selectively removing said conducting film exposed on said island region with said [redacted] and [redacted] serving as at least a part of the mask,

FIG. 3c



a sixth step for depositing a surface passivation film, and a seventh step for selectively removing said surface passivation film and exposing a part of each of said [redacted] and [redacted].

FIG. 3d



As can be seen, claim 1 of the '737 patent recites a process for producing a TFT. As previously mentioned, this TFT can be used to control a pixel in an LCD. In fact, the elongated source electrode 16 shown in Figure 3c and 3d above is taught to be used as a "picture cell electrode" (or pixel electrode) for just such an

application. LPL Exs. at 310 (3:41-44).

Note that the second step of the claimed process calls for the continuous deposition of gate insulating film 3, the high-resistivity semiconductor film 4, and conducting film 20 (which, in this embodiment is made up of only a low-resistivity amorphous semiconductor layer), as shown in Figure 3b above, without exposure to an oxidizing atmosphere. This step is of particular importance in ensuring good electrical contact between the drain and source electrodes 15, 16 of the claimed TFT. Note that the conducting film 20 acts as a contact between the semiconductor film 4 and the drain and source electrodes 15, 16. Oxide gives rise to electrical resistance and, therefore, the development of substantial oxidation between the semiconductor film and conducting film can inhibit current flow between the source and drain electrodes through the semiconductor film when the TFT is activated. LPL Exs. at 309-310 (1:32-46; 3:53-4:2).

As discussed above, in operation, when gate electrode 2 is energized, high-resistivity semiconductor film 4 becomes conductive and conducts electrical current between the drain and source electrodes 15, 16.

C. Construction of Disputed Terms in the '737 Patent

The parties have outlined their disputes with regard to the construction of the claims of the '737 patent in Exhibit D to the JCC. The following addresses various disputes with respect to certain terms contained therein.

1. "thin-film transistor"

LPL construes the term "thin film transistor" in accordance with the definitions and portions of the specification discussed in Section IV(A)(1), *supra*. *See* JCC at 89. Defendants' construction differs from LPL's in one important respect -- Defendants fail to acknowledge that TFTs, by definition, are not constructed in a single crystal silicon wafer. *See id.* This is an important distinction between thin-film transistors and other types of semiconductor devices. The distinction is noted in technical dictionaries contemporary to the filing date of

the '737 patent. Compare LPL Exs. at 331 (defining "thin film transistor" as "fabricated using thin-film techniques on an insulating substrate rather than on a semiconductor chip.") with *id.* at 327 (defining "chip" as "[a] small piece of a single crystal of semiconductor material"). This distinction is also noted in the intrinsic evidence. *See* USPN 4,426,407 1:13-22 ("A thin-film transistor (TFT) is . . . similar to a MOS transistor (metal-oxide semiconductor) with the difference that it is produced on an amorphous substrate and not on a monocrystalline [i.e., single crystal] silicon wafer.") (emphasis added) (LPL Exs. at 320). Accordingly, this distinction is appropriately part of the construction of the term.

2. "source electrode"

The specification of the '737 patent teaches the source electrode being formed via the deposition and patterning of electrically conductive materials, such as metal films, using etching techniques. LPL Exs. at 309 (1:25-29). Moreover, the specification shows a portion of the source electrode formed over the source region of semiconductor layer (*e.g.*, the portion of the semiconductor that, when activated, conducts charge to or from the source electrode). *Id.* at 306, 309 ('737 patent, 1:21-24; Fig. 1c). Accordingly, LPL construes this term as "[a] patterned, electrically conductive material formed over the source region." JCC at 136. LPL's construction of this term also notes that, as discussed in Section IV(A), *supra*, that "[c]urrent flows through the channel between the source electrode and drain electrode under control of the gate electrode." *Id.*

Defendants' proposed construction of this term, while similar to LPL's in some respects, contains several additional limitations that significantly and improperly narrow the meaning of the term. For example, they attempt to limit the term "source electrode" by explicitly stating that it is "distinct from the source/data line and the source/data pad." JCC at 136. There is no such exclusion in the specification or prosecution history of the '737 patent. Moreover, none of the dictionary definitions cited in the JCC for "source electrode" suggest such an

exclusion is appropriate. Also, Defendants' definition states that "charge carriers flow [from the source electrode] into the channel toward the drain." *Id.* While current can be directed in such a fashion in a TFT, it can also travel in the opposite direction. In fact, the embodiment shown in Figure 3 of the '737 patent illustrates such an arrangement. The specification teaches that the source electrode in that embodiment doubles as a picture cell (or pixel electrode) which, as discussed in Section IV(A), collects charge carriers from the channel. LPL's Exs. at 310 ('737 patent at 3:36-44). Thus, in this embodiment, charge carriers flow from the drain through the channel toward the source.

The terms "drain electrode" (JCC at 139-140) and "gate electrode" (*id.* at 93-94) should be construed using the same reasoning. Defendants' definition of "drain electrode," for example, specifies the drain region is where "charge carriers flow from the source into the channel." JCC at 139 (emphasis added). As noted above, this direction of charge carrier flow can be reversed in TFTs, and is in fact reversed in the embodiment of the invention shown in Figure 3 of the '737 patent.

Also, Defendants' definition of "gate electrode" excludes "the gate line and the gate pad". JCC at 93-94. As in the case of the term "source electrode" above, there is no support in the intrinsic evidence or cited dictionary definitions for such an exclusion. In fact, the specification indicates that gate lines should be included in the definition of "gate electrode". *See* LPL Exs. at 310 ('737 patent at 3:24-28 ("FIG. 3a illustrates a step in which gate electrode 2 extending along one line [is] formed on a transparent insulating substrate 1 such as glass substrate.") (emphasis added)).[4]

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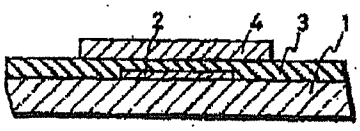
[4] While Defendants' proposed constructions of "source electrode" and "gate electrode" specifically exclude source/gate line and source/gate pad structures, even though such an exclusion is unsupported in either the intrinsic evidence or dictionary definitions, their construction of "drain electrode" does not exclude data line and/or pad structures. Id.

3. "continuously depositing"

LPL construes this term as: "[t]he formation of the gate insulating film, the high-resistivity semiconductor film and conducting film without intervening films." JCC at 95-96. Defendants' construction requires "[s]uccessively depositing each constituent film on top of the underlying film or structure without interruption and without performing any processing steps between the deposition of each constituent film." *Id.*

FIG. 1b PRIOR ART



LPL's definition is consistent with the plain meaning of the term "continuously" because it requires the films to be deposited so that they are spatially continuous. *See 1981 Webster's* 243-44 (defining "continuous" is defined as "marked by uninterrupted extension in space, time, or sequence") (emphasis added) (Defendants Exs. 3 at 472-73). LPL's definition is also consistent with the specification, which states that "as shown in FIG. 1b, a gate insulating film 3 (such as silicon nitride film) and an amorphous silicon film 4 are continuously deposited, and said amorphous silicon film 4 is selectively etched." LPL Exs. at 309 (1:17-21) (emphasis added). Figure 1b, shown above right, does not show that films 3 and 4 are deposited without any timewise interruption and without any intervening processing steps, as Defendants propose. Instead, Figure 1b simply depicts amorphous silicon film 4 deposited on the gate insulating film 3 without intervening films, as shown above right. Accordingly, the '737 patent specification does not support Defendants' construction.

LPL's construction of "continuously depositing" is also consistent with the object of the invention of the '737 patent – a simplified process for producing a thin film transistor with an improved contact arrangement. LPL Exs. at 309 (1:56-58). As discussed in the Background of the Invention, prior art processes resulted in the formation of an intervening film, a natural oxide layer, between the high-resistivity

silicon film and the low-resistivity silicon film. LPL Exs. at 309 (1:32-35). LPL's construction of "continuously depositing" excludes such an intervening film.

Defendants' proposed construction also contradicts the aforementioned *Webster's* dictionary definition of "continuous," which defines "continuous" as "uninterrupted in space, time or sequence. Defendants Ex. 3 at 472-73 (emphasis added). Defendants construe "continuously depositing" to require 1) successively depositing each constituent film on top of the underlying film, 2) without interruption, and 3) without performing any processing steps between the deposition of each constituent film. Defendants thus construe "continuous" to prevent interruption in space, time, and sequence. Moreover, Defendants' definition has no foundation in the intrinsic evidence, and adds unwarranted ambiguity to the term "continuously depositing." In particular, nowhere does the '737 patent specification or file history prohibit "interruption" or "performing any processing steps between the deposition of each constituent film." (Emphasis added.) Moreover, Defendants' definition invites confusion as to what constitutes an "interruption" and/or a "processing step."

4. "high-resistivity semiconductor film" and "low-resistivity semiconductor film"

The primary distinction between LPL and Defendants' constructions of these terms is the manner in which the parties distinguish the "high-resistivity semiconductor film" from the "low-resistivity semiconductor film" and vice versa. *See* JCC at 102-103, 112-113. LPL distinguishes the two via comparison to the relative resistivity of the two films. For example, LPL construes the term "high-resistivity semiconductor film" as "[a] thickness of semiconductor material . . . that has a higher resistance to current flow relative to the low-resistivity semiconductor film" JCC at 102-103. Such a definition is consistent with the plain and ordinary meaning of each term. The '737 patent discloses adding impurities, such as phosphorous, to the semiconductor material to produce the low-resistivity

semiconductor film. LPL Exs. at 309 (2: 26-29, 43-45). This process of enhancing the conductive properties of semiconductor material (and thereby lowering the resistivity) by the addition of impurities is called "doping." Generally, the more impurities are added, or the higher the "doping level," the more conductive the semiconductor material. Consider, for example, the following definition of the term "doping level" taken from a technical dictionary contemporary to the time of the '737 invention: "[t]he amount of doping necessary to achieve the desired characteristic in a semiconductor. Low doping levels . . . give a high-resistivity material; high doping levels . . . give a low-resistivity material." *Id.* at 337 (emphasis added). One of skill, reading the specification of the '737 patent, would understand the term "high-resistivity semiconductor" to refer to semiconductor material that is undoped or that has a low doping level, and, therefore, has a higher resistance to current flow relative to a highly doped, or low-resistivity semiconductor. Similarly, one of skill, reading the specification of the '737 patent, would understand the term "low-resistivity semiconductor" to refer to semiconductor material with a high doping level, and one that, therefore, has a low resistance to current flow relative to a less doped, or low-resistivity semiconductor.

Defendants' constructions of these terms, on the other hand, inject vague and unwarranted limitations drawn from extrinsic evidence to distinguish the two films. For example, they construe the high-resistivity semiconductor material to have an "electrical resistance many orders of magnitude higher than a low-resistivity semiconductor film." JCC at 102-103 (emphasis added). Once again, Defendants attempt to add limitations to the term that have no basis in the intrinsic evidence and add additional ambiguity to the term. *See Biovail Corp.*, 239 F.3d at 1301. Nowhere in the specification is there a requirement regarding "many orders of magnitude" between the electrical resistance of low and high-resistivity semiconductor films. Moreover, Defendants' definitions invite confusion as to what, quantitatively, constitutes "many orders of magnitude."

5. "conducting film" and "conducting film containing at least a low-resistivity semiconductor film"

The primary distinction between LPL and Defendants' constructions of this term and phrase is whether a "low-resistivity semiconductor film" by itself meets the phrase "a conducting film containing a least a low-resistivity semiconductor film." LPL defines the term "conducting film" as "[a] thickness of electrically conductive material" and defines the phrase "conducting film containing at least a low-resistivity semiconductor film" as "[t]he conducting film is composed of a low-resistivity semiconductor film and possibly other conductive films." JCC at 106, 116. Thus, according to LPL's construction, claim 1 requires "a conducting film" that is made up of at least the "low-resistivity semiconductor film." Defendants' constructions, on the other hand, characterize the "low-resistivity semiconductor film" as distinct from the "conducting film." *See id.*

The '737 patent claims clearly use the phrase "conducting film containing at least a low-resistivity semiconductor film" to mean that the low-resisitivity semiconductor film is a component (and possibly the sole component) of the "conducting film." LPL Exs. at 310. Applying a plain and ordinary meaning to the term "containing," it is clear this phrase characterizes the makeup of the conducting film, namely that it includes at least the low-resistivity semiconductor film. *See* LPL Exs. at 354-355 (defining "contain" as "to have as component parts; comprise; include"). Moreover, the ordinary meaning conveyed by the phrase "at least" is that the conducting film may be made up solely of the low-resistivity semiconductor film or of the low-resistivity semiconductor film and additional material.

This construction is supported by the remainder of claim 1. For example, claim 1 also recites "a fifth step for selectively removing said conducting film exposed on said island region." LPL Exs. at 310 (4:39-42). The corresponding portion of the specification discussing this step explicitly states that the "exposed

portion of low-resistivity amorphous silicon film 20 is removed." *Id.* at 307-308, 310 (3:40-41; Figs. 2d and 3c (showing the claimed TFT after the exposed portion of the low-resistivity amorphous silicon film 20 is selectively removed)). Further, claim 2 of the '737 patent recites "said conducting film is composed of at least two layers consisting of a low-resistivity semiconductor film and thereon a refractory metal film or transparent conducting film." *Id.* at 310 (4:47-54) (Emphasis added.) Claim 2 makes clear the recited "conducting film" is to be composed of, among other films, a low-resistivity semiconductor film.

In contrast, Defendants limit the construction of "conducting film" by requiring the film to have "an electrical resistance several orders of magnitude lower than low-resistivity semiconductor film", and thereby excluded a low-resistivity semiconductor film from being a "conducting film." JCC at 106-107. Thus, Defendants' construction of "a conducting film containing at least a low-resistivity semiconductor film" requires two films – a metal conducting film (which cannot be made of a low-resistivity semiconductor) and a low-resistivity semiconductor film. Such a construction directly contradicts the plain language of claims 1 and 2. Claim 1 explicitly recites that the conducting film contains "at least a low-resistivity semiconductor film," while claim 2 recites that the conducting film "is composed of at least two layers [including] a low-resistivity semiconductor film." Defendants' construction also prohibits the conducting film from including a low-resistivity semiconductor film, in contrast to claim 2, which specifically states that the "conducting film" is composed of a low-resistivity film.[5] Further, Defendants' construction fails to read on the embodiment of the invention shown in Figure 3d, which has only a low-resistivity semiconductor without an adjoining

[5] Several of Defendants' other constructions similarly refuse to recognize that the "conducting film" includes the "low resistivity semiconductor film". See "selectively etched" at JCC, p. 129 (referring to a "conducting film" and a distinct "low-resistivity semicondutor film"); "without exposing them to an oxidizing atmosphere" at id., p. 124-125 (same); "island region on said gate electrode" at id., p. 133 (same).

strip of metal. *See* LPL Exs. at 308. Moreover, nowhere in the '737 patent disclosure is there a requirement regarding the relative "several orders of magnitude" between the electrical resistance of conductive and low-resistivity semiconductor films. Again, Defendants plainly, and improperly, seek to read limitations into the claim which do not even exist in the specification or prosecution history of the '737 patent. *See Biovail Corp.*, 239 F.3d at 1301. Also, Defendants' definition invites confusion as to what, quantitatively, constitutes "several orders of magnitude." For at least these reasons, LPL's definitions should therefore be adopted.

6. "oxidizing atmosphere" and "without exposing them to an oxidizing atmosphere"

The '737 patent teaches "continuously depositing" the films that make up the channel, source, and drain "without exposing them to an oxidizing atmosphere" in order to prevent the development of electrical resistance between the films. *See* LPL Exs. at 309 (1:41-44) ("[Exposure to an oxidizing atmosphere] would give rise to electrical resistance between the source and drain and between channels in the thin-film transistor thus obtained, making such transistor unable to exhibit its desired characteristics."). Thus, one of ordinary skill reading the specification would understand the language at issue in the claim calls not for an absolute ban on oxidation, but rather for steps to be taken to prevent substantial oxidation that would impair the electrical contact between the films. Practical limitations in fabrication techniques used in "continuously depositing" these layers may very well expose the films to insubstantial amounts of oxidizing atmosphere which could, in turn, develop trace oxide deposits on the surface of one or more films. Such trace oxide deposits would have little or no effect on electrical resistance, and as such would still meet the objective of the claimed invention. Accordingly, LPL defines the term "oxidizing atmosphere" as "an atmosphere that would create substantial oxidation on a film" (*i.e.*, an amount of oxidation that will give rise to electrical

resistance such that the transistor is unable to exhibit its desired characteristics). JCC at 121.

Defendants, on the other hand, define the term as "[a]n atmosphere that would create an oxide on a film." *Id.* Under Defendants' construction, the claim requires the exclusion of even insubstantial amounts of oxidation without consideration of whether said oxidation would be sufficient to cause increased electrical resistance. Such a definition is unduly rigid and inconsistent with real world fabrication techniques. Accordingly, LPL's definition should be adopted.[6]

7. "island region"/"island region on said gate electrode"

LPL defines the term "island region" as "[a] discrete portion of the high-resistivity semiconductor film and conducting film that is formed by selective etching" and the phrase "island region on said gate electrode" as "[a] discrete portion of the high-resistivity semiconductor film and conducting film that is formed by selective etching. The discrete portion is located above and supported by or in contact with the gate electrode." JCC at 131-133. These definitions are consistent with the description of the island region contained in the specification. *See* LPL Exs. at 307-309 (2:54-57; Figs. 2c-2e, 3c-3d).

Defendants' definitions of this term and phrase, however, include several unwarranted limitations, such as "etched around its entire perimeter into a separate isolated region located over the gate electrode of a single thin-film transistor." JCC at 133. First, contrary to Defendants' construction, there is nothing in the plain meaning of "island region on said gate electrode" that limits the island region to an isolated region located over the gate electrode of a single TFT. Moreover, there is

[6] There are several other terms at issue where, similarly, Defendants adopt unduly rigid constructions that one of skill would recognize as inconsistent with real world fabrication techniques. They include "selectively removing" (JCC at 142-143) (requiring removal in "selected regions only", presumably excluding the possibility that a slight imperfection in the etching process may result in removal of a tiny amount of material outside of the "selected region") and "selectively forming" (id. at p. 134-135) (same).

nothing in the '737 patent disclosure or prosecution history that limits the island region to a single TFT. Once again, Defendants construction seeks to inject unsupported limitations into claim 1. *See Biovail Corp.*, 239 F.3d at 1301.

Furthermore, there is nothing in the specification of the '737 patent requiring the "entire perimeter" of the island region to be etched "into a separate isolated region". The various two dimensional cutaways of the TFT shown in Figures 2c-2e and 3c-3d of the specification do show a portion of the island region located over the gate. *See* LPL Exs. at 307-308. However, there is nothing in the '737 patent specification or figures that in any way limits the extension of the island region in the dimension perpendicular to the figure (*e.g.*, in or out of the page) or in other areas of the substrate not depicted in the cross sectional views. The phrase "on said gate electrode" does not require that the perimeter of the island region be located over the gate electrode, as Defendants suggests. Note, for example, that claim 1 also recites that the gate insulating film is "on said gate electrode." *Id.* at 310 (4:27-30). Figures 2a-2e and 3b-3d show an example where the gate insulating film 3 is on gate electrode 2 and in various additional locations on the substrate 1 beyond gate electrode 2. *Id.* at 307-308. Clearly, the phrase "on said gate electrode" in claim 1 does not require that a perimeter of the gate insulating film be located over the gate electrode. Such a construction is contradicted by the '737 patent specification, which plainly shows the gate insulating film "on said gate electrode" and elsewhere on the substrate 1. The perimeter of the gate insulating film is not limited to the region located over the gate electrode. Once again, Defendants attempt to improperly limit claim language even to the point of ignoring the intrinsic evidence.

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8. "a fourth step for selectively forming a source electrode and drain electrode"

LPL construes this phrase as "[t]he source electrode and drain electrode are selectively formed together." JCC at 135. LPL's definition recognizes, as stated plainly in the '737 patent, that the source and drain electrodes are formed at the same time in the claimed process for producing a TFT. The phrase at issue recites "a fourth step for selectively forming a source electrode and a drain electrode." (Emphasis added.) Note that the source and drain electrodes are recited as being formed in the same step. Similarly, the specification describes the source and drain electrodes being deposited and etched at the same time. *See* LPL Exs. at 309-10 (1:25-29; 3:36-41).

Defendants, on the other hand, construe this phrase as "[f]orming a source electrode and drain electrode in selected regions only by depositing a conducting film or other material such as Al." JCC at 135. Defendants' definition is deficient in several respects. First, it fails to acknowledge one feature of the claimed invention – namely that both the source and drain electrodes are formed in the same step. Additionally, Defendants' construction can be read to require "forming" the source and drain electrodes via deposition alone, *i.e.*, without subsequent etching to form the desired pattern for the electrodes. Nothing in the plain meaning of the term "forming" suggests such a narrow construction. Moreover, the specification clearly teaches that source and drain electrodes can be formed via deposition and subsequent etching of conductive material. *See* LPL Exs. at 309 (1:25-29). For at least these reasons, LPL's construction should be adopted.[7]

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[7] There are several other terms at issue where, similarly, Defendants' construction of the term "forming" can be read to require deposition alone (without subsequent etching). They include "selectively forming" (JCC at 134-135) and "forming . . . on" (id. at 148).

9. "contacting a part of the surface of said island region"

LPL construes this phrase to mean "[f]orming an electrical connection to a part of the surface of the island region" while Defendants construes it to require "[t]ouching a part of the surface of the island region." JCC at 141. The claim states, in relevant part, "a source electrode and a drain electrode both contacting a part of the surface of said island region." LPL Exs. at 310 (4:36-39). At several places in the specification, the patent discusses the importance of maintaining electrical connectivity between the various layers that make up the island region as well as between the island region and the layers which are patterned to form the source and drain electrodes. *See id.* at 307-310 (3:53-62, 4:1-2; Figs. 2d-2e; 3c-3d). In fact, throughout the specification, the term "contact" is used consistently in the context of forming an electrical connection. *See id.* at 309-310 (1:21-25; 1:55-57; 3:59-4:2). Accordingly, LPL's definition should be adopted as a more appropriate reading of the claim term "contact" in light of the specification.

10. "at least a part of the mask"/ "said source and drain electrodes serving as at least part of the mask"

A mask is a device used to shield selected areas of a semiconductor chip during the manufacture of semiconductor components and integrated circuits. Of particular relevance to this case, a mask is used to form a pattern in a surface of a film or films during the fabrication of a TFT. *See, e.g.*, '758 patent at 5:37-6:7 (discussing the use of mask in forming source bus patterns in a conductive layer) (LPL Exs. at 316). In application, a mask is typically formed in a desired pattern above a surface from which material is to be selectively removed. *See, e.g., id.* at 5:37-56 (describing one method of developing a mask). Then, a removal technique, such as the application of an etching solution, is applied that will remove portions of the exposed surface but not the mask. *See, e.g., id.* at 5:57-59 ("A suitable etching solution will then be employed to remove the unprotected conductive layer . . .") Obviously, for this technique to work the mask must be made of material that

is resistive to the removal technique relative to material to be removed. The ultimate result of this process is that a pattern matching the mask will be left in the surface following the application of the removal technique. *See, e.g., id.* at 6:6-7 ("The structure now has the configuration shown in FIGS. 6 and 6A"). Accordingly, LPL defines the term "mask" as "a pattern above a surface from which material is to be selectively removed" where "the pattern is made of material that is resistive to the removal technique relative to material to be removed." JCC at 145-147. The remainder of the phrases at issue ("at least a part of the mask"/"said source and drain electrodes serving as at least part of the mask") are either otherwise construed (*e.g.* source and drain electrode) or have plain meanings (*e.g.*, "serving as at least part of" the mask means there can be other parts to the mask) and the phrases should be construed accordingly.

Defendants' constructions of these phrases fail to define the term mask, and add limitations contrary to a plain reading of the phrases. For example, the claim requires only that the source and drain electrode serve as "at least a part of the mask." (Emphasis added.) Defendants, however, read this qualified limitation to mean the source and drain electrode must "make a significant contribution to defining the edges of the selectively removed region." JCC, Exh. at 146-47 (emphasis added). There is simply no logical reason for requiring a structure identified as only making up "at least a part" of the mask to make a "significant contribution to defining the edges of the selectively removed region." If, for example, the source and drain electrodes made up only a small portion of the mask, they would still account for "at least a part" of the mask as required by the claim. Defendants construction, however, would further require this small portion of the mask accounted for by the electrodes to make a "significant" contribution to defining the "edges of the removed region." Such an encumbrance of this limitation is unsupported, unwarranted, and in clear contravention of the plain meaning of the phrase "at least a part of the mask" as recited in the patent.

Moreover, Defendants' definition is fraught with ambiguity. For example, how much of "contribution" is required to be considered a "significant" contribution? Similarly, what constitutes the "edges of the selectively removed region"? There is no reason to import these ambiguous, unsupported, and extraneous limitations into the claim. Accordingly, LPL's construction should be adopted.

D. '449 Patent Claims

The '449 patent discloses and claims an LCD device and a method of manufacturing said device, which, among other things, has a novel interconnection structure. LPL Exs. at 380-81 (2:30-3:14). The claims of the '449 patent fall into two main categories: (1) claims directed to a "wiring structure" and (2) claims directed to a "liquid crystal display device." This same novel interconnection is included in both categories of claims. To illustrate the nature of the interconnection recited in the claims of the '449 patent, LPL presents the following illustration which correlates the structures recited in claim 1 with the corresponding elements of Figure 5 of the patent describing one embodiment of the claimed invention.

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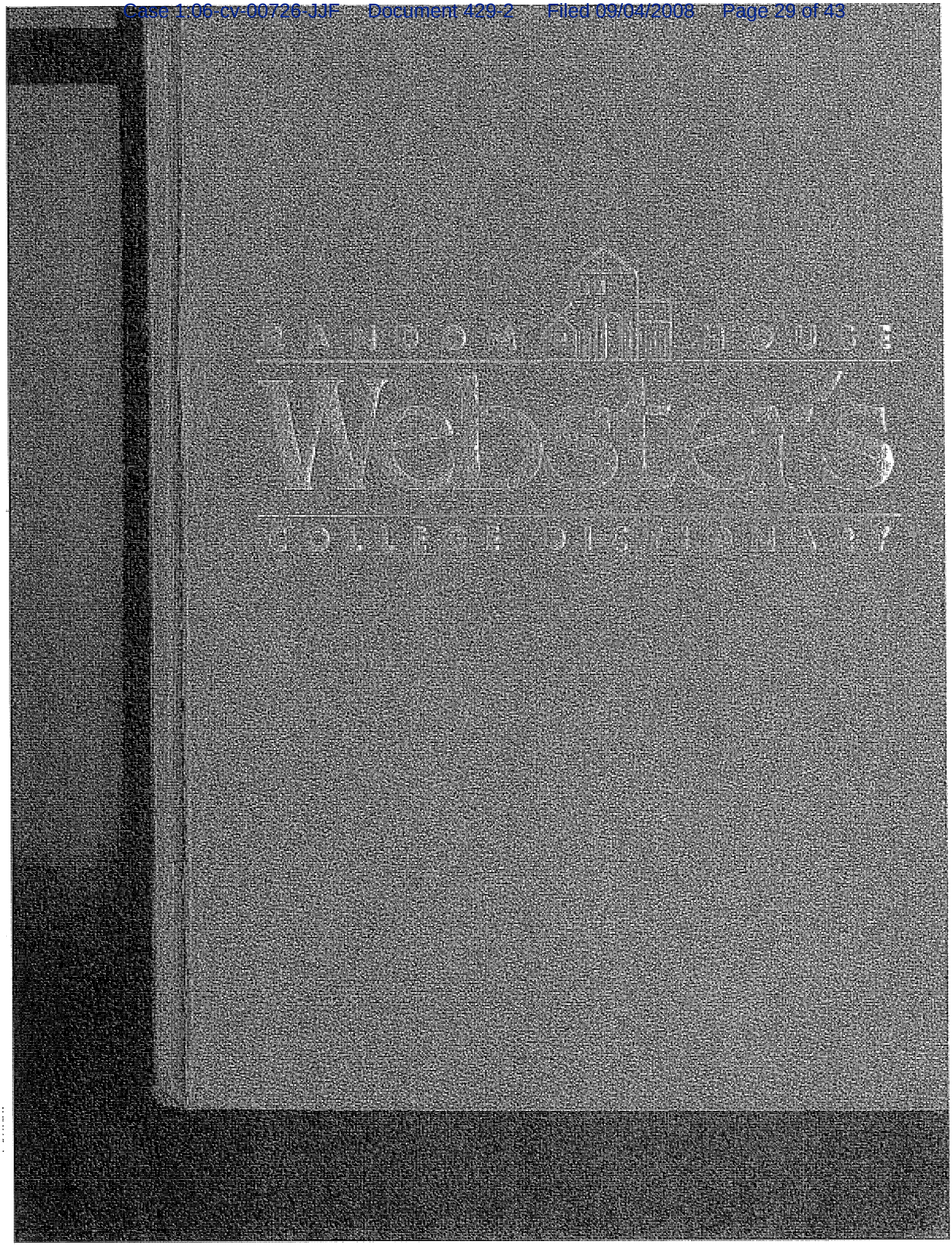
Exhibit 2



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fingeta to forgive, Go *fragiban* to bestow; see FOR-, GIVE] —**for·giv′a·ble**, *adj.* —**for·giv′er**, *n.* —**Syn.** See EXCUSE.

for·give·ness (fər giv′nis), *n.* **1.** the act of forgiving or the state of being forgiven; pardon. **2.** willingness to forgive. [bef. 900]

for·giv·ing (fər giv′ing), *adj.* **1.** disposed to forgive or showing forgiveness. **2.** offering the chance to recover from mistakes; tolerant: *This slope is forgiving of inexperienced skiiers.* [1680–90] —**for·giv′ing·ly**, *adv.* —**for·giv′ing·ness**, *n.*

for·go or **fore·go** (fôr gō′), *v.t.*, **-went, -gone, -go·ing. 1.** to abstain or refrain from; give up; renounce. **2.** *Archaic.* to neglect; overlook. **3.** *Archaic.* to quit or leave. [bef. 950] —**for·go′er**, *n.*

for·got (fər got′), *v.* a pt. and pp. of FORGET.

for·got·ten (fər got′n), *v.* a pp. of FORGET.

for·int (fôr′int), *n.* the basic monetary unit of Hungary. See table at CURRENCY. [1945–50; < Hungarian < It *fiorino*. See FLORIN]

for·judge or **fore·judge** (fôr juj′), *v.t.*, **-judged, -judg·ing.** *Law.* to exclude, expel, or deprive by a judgment. [1250–1300; ME *forjugen* < OF *forjugier* = *for-* out (see FORFEIT) + *jugier* to JUDGE] —**for·judg′ment**, *n.*

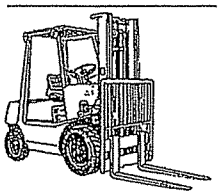
fork (fôrk), *n.*, *v.*, **forked, fork·ing.** —*n.* **1.** an instrument having two or more prongs or tines, for holding, lifting, etc., esp. an implement for handling food. **2.** something resembling this in form. **3.** a division into branches. **4.** the point or part at which a thing, as a river or a road, divides into branches. **5.** either of the branches into which a thing divides. **6.** a principal tributary of a river. —*v.t.* **7.** to pierce, raise, pitch, dig, etc., with a fork. **8.** to make into the form of a fork. **9.** to maneuver so as to place (two opposing chess pieces) under simultaneous attack by the same piece. —*v.i.* **10.** to divide into branches, as a road. **11.** to turn as indicated at a fork in a road, path, etc. **12.** *Informal.* **fork over, out,** or *up,* to deliver; pay; hand over. [bef. 1000; ME *forke*, OE *forca* < L *furca* fork, gallows, yoke] —**fork′less**, *adj.* —**fork′like′**, *adj.*

fork·ball (fôrk′bôl′), *n.* a baseball pitch thrown with the ball inserted between the index and middle fingers, causing it to dip sharply near home plate. [1920–25, *Amer.*]

forked (fôrkt, fôr′kid), *adj.* **1.** having a fork or forklike branches. **2.** zigzag, as lightning. —***Idiom.*** **3. to speak with or have a forked tongue,** to speak deceitfully; attempt to deceive. [1250–1300] —**fork·ed·ly** (fôr′kid lē), *adv.* —**fork′ed·ness**, *n.*

fork·ful (fôrk′fo͝ol), *n., pl.* **-fuls.** the amount a fork can hold. [1635–45] —**Usage.** See -FUL.

fork·lift (fôrk′lift′), *n., v.*, **-lift·ed, -lift·ing.** —*n.* **1.** Also called **fork′lift truck′, fork′ truck′.** a small vehicle with two power-operated prongs at the front that can be slid under heavy loads in order to lift, carry, and stack them, as in warehouses. —*v.t.* **2.** to move or stack by forklift. [1940–45]



forklift (def. 1)

fork·y (fôr′kē), *adj.*, **fork·i·er, fork·i·est.** forked. [1500–10] —**fork′i·ness**, *n.*

For·li (fôr lē′), *n.* a city in N Italy, SE of Bologna. 110,334.

for·lorn (fôr lôrn′), *adj.* **1.** miserable, as in condition or appearance; dreary; wretched. **2.** lonely and sad; forsaken; desolate. **3.** expressive of hopelessness; despairing: *forlorn glances.* **4.** bereft; destitute: *forlorn of comfort.* [bef. 1150; ME *foreloren*, ptp. of *forlesen* to forfeit, desert, OE *forlēosan*; c. OS, OHG *farliosan*, Go *fraliusan*. See FOR-, LOSE] —**for·lorn′ly**, *adv.* —**for·lorn′ness**, *n.*

forlorn′ hope′, *n.* **1.** a perilous or desperate enterprise. **2.** a vain hope. **3.** *Obs.* a group of soldiers assigned to perform some unusually dangerous service. [1530–40; folk-etymological alter. of D *verloren hoop* lit., lost troop]

form (fôrm), *n., v.*, **formed, form·ing.** —*n.* **1.** external appearance of a clearly defined area, as distinguished from color or material; configuration: *a triangular form.* **2.** the shape of a thing or person. **3.** a body, esp. that of a human being. **4.** a dummy having the same measurements as a human body, used for fitting or displaying clothing. **5.** something that gives or determines shape; a mold. **6.** a particular condition, character, or mode in which something appears: *water in the form of ice.* **7.** the manner or style of arranging and coordinating parts for a pleasing or effective result, as in literary or musical composition. **8.** the organization, placement, or relationship of basic elements, as lines and colors in a painting or volumes and voids in a sculpture, so as to produce a coherent image; the formal structure of a work of art. **9.** a particular kind, type, species, or variety, esp. of a zoological group. **10.** the combination of all the like faces possible on a crystal of given symmetry. **11.** due or proper shape; orderly arrangement of parts; good order. **12.** *Philos.* **a.** the structure, organization, or essential character of something, as opposed to its matter. **b.** (*cap.*) *Platonism.* IDEA (def. 8c). **c.** *Aristotelianism.* that which places a thing in its particular species or kind. **13.** a set, prescribed, or customary order or method of doing something. **14.** a set order of words, as for use in religious ritual or in a legal document; formula. **15.** a document with blank spaces to be filled in with particulars before it is executed: *a tax form.* **16.** a typical document to be used as a guide in framing others for like cases: *a form for a deed.* **17.** a conventional method of procedure or behavior: *society's forms.* **18.** a formality or ceremony, often with implication of absence of real meaning. **19.** procedure according to a set order or method. **20.** conformity to the usages of society; formality; ceremony. **21.** procedure or conduct, as judged by social standards: *Good form demands that we go.* **22.** manner or method of performing something; technique: *The violinist displayed excellent form.* **23.** physical condition or fitness, as for performing: *a tennis player in peak form.* **24. a.** LINGUISTIC FORM. **b.** a particular shape of a word that occurs in more than one shape: *In I'm, 'm is a form of am.* **c.** a word with a particular inflectional ending or other modification: *Goes is a form of go.* **d.** the external shape or pattern of a word or other construction, as distinguished from its meaning, function, etc. **25.** temporary boarding or sheeting of plywood or metal for giving a desired shape to poured concrete, rammed earth, etc. **26.** a grade or class of pupils in a British secondary school or in certain U.S. private schools. **27.** a bench or long seat. **28.** an assemblage of printing types, leads, etc., secured in a chase to print from.

—*v.t.* **29.** to construct or frame. **30.** to make or produce. **31.** to serve to make up; compose; constitute: *Three citizens form the review board.* **32.** to place in order; arrange; organize. **33.** to frame (ideas, opinions, etc.) in the mind. **34.** to contract or develop (habits, friendships, etc.). **35.** to give form or shape to; shape; fashion. **36.** to give a particular form or shape to: *Form the dough into squares.* **37.** to mold or develop by discipline or instructions. **38.** to produce (a word or class of words) by adding an affix, combining elements, or changing the shape of the form: *to form the plural by adding -s.* —*v.i.* **39.** to take or assume form. **40.** to be formed or produced: *Ice began to form on the window.* **41.** to take a particular form or arrangement: *The ice formed in patches across the window.* [1175–1225; ME *forme* < OF < L *fōrma* form, mold, sort, ML: seat] —**form′a·ble**, *adj.* —**form′a·bly**, *adv.*

-form, a combining form meaning "having the form of": *cruciform.* [< L *-fōrmis*]

for·mal (fôr′məl), *adj.* **1.** being in accordance with the usual requirements, customs, etc.; conventional: *to pay one's formal respects.* **2.** marked by form or ceremony: *a formal occasion.* **3.** designed for wear or use at elaborate ceremonial or social events: *The invitation specified formal attire.* **4.** requiring dress suitable for elaborate social events: *a formal dance.* **5.** observant of conventional requirements of behavior, procedure, etc., as persons; punctilious. **6.** excessively ceremonious; prim; decorous. **7.** being a matter of form only; perfunctory: *formal courtesy.* **8.** made or done in accordance with procedures that ensure validity: *a formal authorization.* **9.** of, pertaining to, or emphasizing the organization or composition of the constituent elements in a work of art perceived separately from its subject matter: *the formal structure of a poem.* **10.** acquired in school; academic. **11.** symmetrical or highly organized: *a formal garden.* **12.** of or pertaining to language use typical of impersonal and official situations, characterized by adherence to traditional standards of correctness, often complex vocabulary and syntax, and the avoidance of contractions and colloquial expressions. **13.** pertaining to the form, shape, or mode of a thing, esp. as distinguished from the substance: *formal writing.* **14.** being such merely in appearance or name; nominal: *a formal head of state.* **15.** *Math.* **a.** (of a proof) in strict logical form with a justification for every step. **b.** (of a calculation) correct in form; made with strict justification for every step. —*n.* **16.** a dance, ball, or other social occasion that requires formal attire. **17.** an evening gown. —*adv.* **18.** in formal attire: *We're supposed to go formal.* [1350–1400; ME < L] —**for′mal·ness**, *n.*

form·al·de·hyde (fôr mal′də hīd′, fər-), *n.* a toxic gas, CH_2O, used chiefly in aqueous solution as a disinfectant and preservative. [1870–75; < G *Formaldehyd*; see FORMIC ACID, ALDEHYDE]

for·ma·lin (fôr′mə lin), *n.* a clear, colorless, aqueous solution of 40 percent formaldehyde. [1893; FORMAL(DEHYDE) + -IN¹]

for·mal·ism (fôr′mə liz′əm), *n.* strict adherence to or observance of prescribed or traditional forms, as in music, poetry, and art. [1830–40] —**for′mal·ist**, *n., adj.* —**for′mal·is′tic**, *adj.* —**for′mal·is′ti·cal·ly**, *adv.*

for·mal·i·ty (fôr mal′i tē), *n., pl.* **-ties. 1.** condition or quality of being formal; accordance with required or traditional rules, procedures, etc.; conventionality. **2.** rigorously methodical character. **3.** strict adherence to established rules and procedures; rigidity. **4.** observance of form or ceremony. **5.** marked or excessive ceremoniousness. **6.** an established order or method of proceeding: *the formalities of judicial process.* **7.** a formal act or observance; ritual. **8.** something done merely or mainly for form's sake; a requirement of custom or etiquette. [1525–35; < L]

for·mal·ize (fôr′mə liz′), *v.t.*, **-ized, -iz·ing. 1.** to make formal, esp. for the sake of official or authorized acceptance: *to formalize an agreement with a legal contract.* **2.** to give a definite form or shape to. [1590–1600] —**for′mal·i·za′tion**, *n.* —**for′mal·iz′er**, *n.*

for′mal log′ic, *n.* the branch of logic concerned with the principles of deductive reasoning and with the form rather than the content of propositions. [1855–60]

for·mal·ly (fôr′mə lē), *adv.* **1.** in a formal manner. **2.** as regards form; in form: *a formally correct composition.* [1350–1400]

for·mal·wear (fôr′məl wâr′), *n.* clothing designed for or customarily worn on formal occasions, as tuxedos and evening gowns. [1965–70]

for·mant (fôr′mənt), *n.* one of the regions of concentration of energy, prominent on a sound spectrogram, that collectively constitute the frequency spectrum of a speech sound. [1900–05; < G (1894) < L *fōrmant-*, s. of *fōrmāns*, prp. of *fōrmāre* to FORM; see -ANT]

for·mat (fôr′mat), *n., v.*, **-mat·ted, -mat·ting.** —*n.* **1.** the shape and size of a book as determined by the number of times the original sheet has been folded to form the leaves. Compare DUODECIMO, FOLIO (def. 2), OCTAVO, QUARTO. **2.** the general physical appearance of a book, magazine, or newspaper. **3.** the organization, plan, style, or type of something. **4.** the arrangement of data for computer input or output, as the number of fields in a database record or the margins in a report. **5.** the programming featured by a radio or television station: *a talk-show format.* —*v.t.* **6.** to plan or provide a format for. **7. a.** to set the format of (computer data input or output). **b.** to prepare (a computer disk) for writing and reading. —*v.i.* **8.** to devise a format. [1830–40; < F < G < L (*liber*) *fōrmātus* (a book) formed (in a certain way)] —**for′mat·ter**, *n.*

for·mate (fôr′māt), *n.* a salt or ester of formic acid. [1800–10]

for·ma·tion (fôr mā′shən), *n.* **1.** the act or process of forming or the state of being formed: *the formation of ice.* **2.** the manner in which a thing is formed; disposition of parts; formal structure or arrangement. **3. a.** a particular arrangement or disposition of persons, as of troops or players on a team. **b.** any required assembling of the soldiers of a unit. **4. a.** a body of rocks classed as a stratigraphic unit for geologic mapping. Compare MEMBER (def. 8). **b.** the process of depositing rock or mineral of a particular composition or origin. [1375–1425; late ME < L] —**for·ma′tion·al**, *adj.*

form·a·tive (fôr′mə tiv), *adj.* **1.** giving form or shape; forming; shaping; fashioning: *a formative process in manufacturing.* **2.** pertaining to formation or development: *a child's formative years.* **3. a.** capable of de-

Exhibit 3

US005410423A

United States Patent [19]

Furushima et al.

[11] **Patent Number: 5,410,423**

[45] **Date of Patent: Apr. 25, 1995**

[54] **METHOD OF FABRICATING A LIQUID CRYSTAL PANEL USING A DUMMY SEAL WHICH IS CLOSED AFTER HARDENING**

[75] Inventors: **Teruhiko Furushima**, Atsugi; **Moriyuki Okamura**, Sagamihara; **Masaru Kamio**, Kawasaki; **Yutaka Genchi**, Atsugi, all of Japan

[73] Assignee: **Canon Kabushiki Kaisha**, Tokyo, Japan

[21] Appl. No.: **19,568**

[22] Filed: **Feb. 18, 1993**

[30] **Foreign Application Priority Data**

Feb. 21, 1992 [JP] Japan 4-070131

[51] **Int. Cl.**[6] **G02F 1/13**

[52] **U.S. Cl.** **359/80**; 359/82; 359/62; 445/24

[58] **Field of Search** 359/80, 59, 82, 62; 257/67, 347; 437/62, 90; 445/24, 25

[56] **References Cited**

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Primary Examiner—William L. Sikes
Assistant Examiner—Kenneth Parker
Attorney, Agent, or Firm—Fitzpatrick, Cella, Harper & Scinto

[57] **ABSTRACT**

In fabricating a liquid crystal panel, preparing a substrate sized larger than the same at a finished state, following to bonding the prepared substrate, an excess peripheral portion of the substrate is cut off. A dummy seal having an opening portion at least in part thereof is formed on the excess portion of the substrate. And, the opening portion of the dummy seal is sealed off to make the dicing after bonding of upper and lower substrates and curing of the seal.

5 Claims, 2 Drawing Sheets

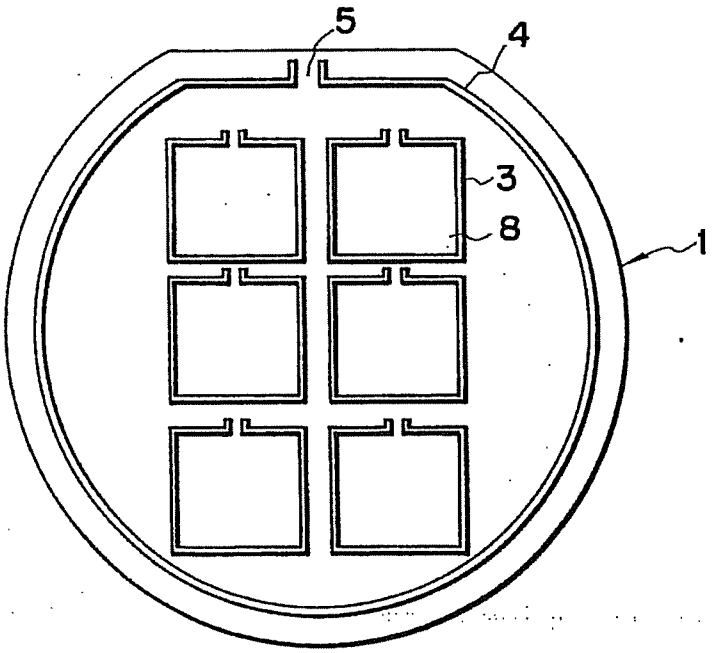


FIG. 1

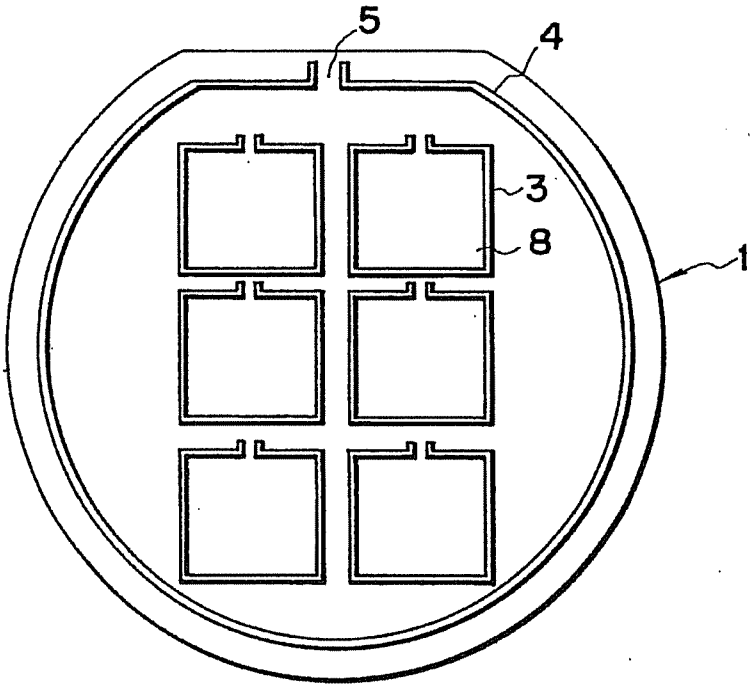


FIG. 2

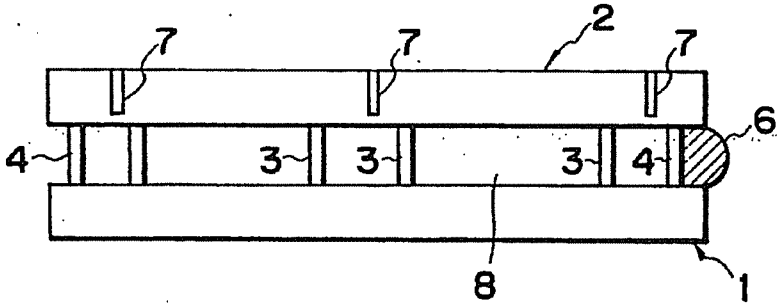


FIG. 3

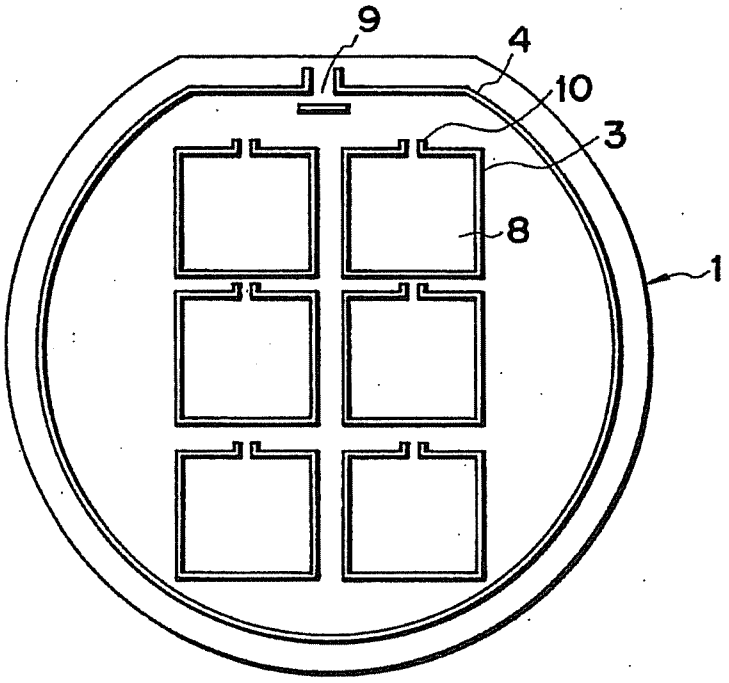
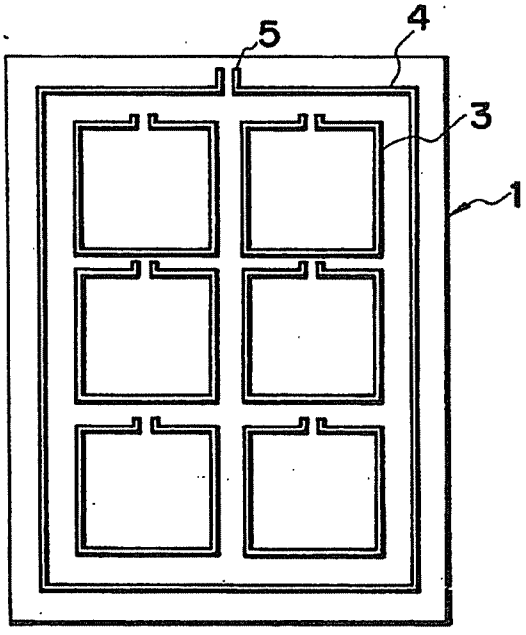


FIG. 4



METHOD OF FABRICATING A LIQUID CRYSTAL PANEL USING A DUMMY SEAL WHICH IS CLOSED AFTER HARDENING

BACKGROUND OF THE INVENTION

1. Field of the Industrial Applicability

The present invention relates to a method of fabricating a liquid crystal panel, and more particularly to a method of fabricating a liquid crystal panel which is produced by using a substrate larger in size than a completed panel substrate, and cutting off excess peripheral portions by dicing, after bonding of substrates.

2. Related Background Art

Conventional liquid crystal panels of the simple matrix type have been fabricated with a slab chocolate method in which a plurality of panel patterns are formed on a large substrate, and such substrates are then bonded and scribed to divide into individual panels. When using a quartz glass or Si wafer for a TFT substrate of the liquid crystal panel, because the scribe is difficult, a dicing method is adopted in which a disk-like grinding stone is rotated for cutting.

However, the dicing method had a problem that because the liquid crystal inlets of the liquid crystal panels were not yet closed at the time of dicing, the cooling water which was necessary to be flowed therethrough in the dicing process might enter the liquid crystal panels.

Means for resolving such a problem has been disclosed in Japanese Patent Application Laid-open No. 63-298219, in which the invasion of the cooling water into the liquid crystal panels is prevented in such a way that a larger substrate than a completed panel substrate is used to form a dummy seal in the excess peripheral portion of the substrate, and the dicing is performed after curing of the seal.

However, the above-described conventional method had a problem that since in bonding two substrates, the internal air might be enclosed by the dummy seal which was formed in a thickness of two to three times a desired cell gap thickness, the air compressed to half or one-third of its volume by a bonding pressure would expand due to heating for curing the seal, thereby enlarging the cell gap, so that a desired cell gap could not be obtained.

SUMMARY OF THE INVENTION

To resolve the above-mentioned conventional problems, it is an object of the present invention to provide a method of fabricating a liquid crystal panel in which the invasion of the cooling water into the liquid crystal panel at the time of dicing is prevented, and the enlargement of the cell gap at the time of heat curing the seal is prevented.

It is another object of the present invention to provide a method of fabricating a liquid crystal panel in which a desired cell gap can be stably obtained, whereby an excellent display can be realized.

It is a further object of the present invention to provide a method of fabricating a reliable liquid crystal panel without restrictions on the temperature condition for the heat curing.

It is still another object of the present invention to provide a method of fabricating a liquid crystal panel in which a larger substrate than a finished panel substrate is cut off excess peripheral portions thereof by dicing after bonding of the substrates, characterized in that a dummy seal having an opening portion at least in part thereof is formed on the excess portion of the substrate, and the opening portion of the dummy seal is sealed off to make the dicing after bonding of upper and lower substrates and curing of the seal.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view showing the state of a substrate before bonding of substrates in the present invention.

FIG. 2 is a schematic view showing one example of a liquid crystal panel after dicing.

FIG. 3 is a schematic view of a substrate before bonding of substrates in the present invention.

FIG. 4 is a schematic view showing the state of a substrate before bonding of substrates in the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The preferred embodiments of the present invention are as follows. That is, a method of fabricating a liquid crystal panel according to the present invention in which a larger substrate than a completed panel substrate is used to cut off excess peripheral portions by dicing after bonding of substrates, is characterized in that a dummy seal having an opening portion at least in part thereof is formed on the excess portion of the substrate, and the opening portion of the dummy seal is sealed off to make the dicing after bonding of upper and lower substrates and curing of the seal.

Since the dummy seal is provided with an opening portion in this invention, a desired cell gap can be obtained without enclosing the air between substrates, whereby a liquid crystal panel which can make excellent display can be fabricated. Further, the variation in the cell gap owing to expansion of the air on heat curing of the sealing material can be prevented. Accordingly, it is possible to fabricate a reliable liquid crystal panel without restrictions on the temperature condition of the heat curing. And since the opening portion of the dummy seal is sealed off before dicing, the invasion of the cooling water into the liquid crystal panel can be prevented.

In the present invention, the material for the dummy seal may be a thermosetting epoxy resin or ultraviolet setting epoxy resin, for example. Specific examples of the thermosetting epoxy resin include XN-21 (trade name) and XN-5A (trade name) made by Mitsui Toatsu Chemical. The thickness of dummy seal is typically in a range from 4 μm to 20 μm, and preferably in a range from 4 μm to 7 μm to be equivalent to a gap thickness of liquid crystal layer. The width of dummy seal is typically in a range from 0.1 mm to 1.5 mm, and preferably in a range from 0.1 mm to 0.5 mm. The dummy seal is formed as in the following way, for example. That is, a seal is printed in a thickness (e.g., about 10 μm to 30 μm) of approximately two to three times the thickness of final seal, and in a print width of about 0.1 mm to 1.5 mm, by seal printing, and then is pressurized and treated with the heat curing to form a dummy seal. In the present invention, the opening portion of the dummy seal is sealed off by an adhesive or epoxy resin.

The present invention will be described below with reference to the drawings.

Embodiment 1

FIG. 1 is an upper view showing a state before bonding of substrates in this embodiment, and FIG. 2 is a

cross-sectional view of a liquid crystal panel after bicing.

A TFT substrate **1** composed of Si wafer on which the electrodes for driving the liquid crystal are formed and the thin film transistors are fabricated and an opposite substrate **2** composed of a low alkali glass of low thermal expansion (AL made by Asahi Glass) were treated for orientation. On one substrate, seals **3** constituting liquid crystal panels **8** and a dummy seal **4** on peripheral excess portion of the substrate, as shown in FIG. **1**, were formed using a sealing material having a spacer mixed for forming a cell gap at good precision.

Two substrates were bonded in a predetermined alignment, pressurized, and heated to cure the seals **3** and the dummy seal **4**. Since an opening portion **5** for the outlet of the air was provided on the dummy seal **4**, it was possible to prevent the variation in the gap width due to thermal expansion of the air on the heat curing.

Then, the opening portion **5** of outer peripheral seal was sealed off by instantaneous adhesive **6**, and diced (half-cut **7**) in which the substrate was not completely cut. The provision of the dummy seal **4** can prevent the invasion of the cooling water into the liquid crystal panels **8** at the time of dicing.

After the dicing, the substrate was dried in a drying process to remove water contents therefrom, and divided into individual panels by applying a shearing force. After dividing, liquid crystal was poured into respective panels, and the inlet of the liquid crystal was sealed by sealant. The processes involving this liquid crystal relied on any of the well-known fabrication techniques for liquid crystal display.

The surface opposite to that as formed with TFT of Si substrate is covered with hydrofluoric acid resistant rubber except for immediately below the liquid crystal pixel portion, and Si wafer was partially removed down to insulation layer, using a mixture solution of hydrofluoric acid, acetic acid and nitric acid, whereby light transmission-type liquid crystal image displays could be completed.

Note that Si wafer for use with the TFT substrate **1** was fabricated by the following method.

Anodization was conducted on a P-type (**100**) monocrystalline Si substrate having a thickness of 300 microns in an HF solution to form a porous Si substrate.

Anodization was performed under the following conditions:

Applied voltage: 2.6 (V)
Current density: 30 ($mA \cdot cm^{-2}$)
Anodizing solution: $HF:H_2O:C_2H_5OH = 1:1:1$
Time: 2.4 (hours)
Thickness of porous Si: 300 (μm)
Porosity: 56 (%)

An Si epitaxial layer with a thickness of 1.0 μm was grown on the P-type (**100**) porous Si substrate by low-pressure CVD. Deposition was conducted under the following conditions.

Source gas: SiH_4
Carrier gas: H_2
Temperature: 850° C.
Pressure: 1×10^{-2} Torr
Growth rate: 3.3 nm/sec

Then, a 1,000 Å oxide layer was formed on the surface of this epitaxial layer, and on this oxide surface, another Si substrate having formed a 5,000 Å oxide layer, a 1,000 Å oxide layer and a 1,000 Å nitride layer on its surface was superposed. The whole structure was heated at 800° C. in a nitrogen atmosphere for 0.5 hour to firmly join the two substrates to each other.

Thereafter, selective etching was conducted on the bonded substrates in a mixed solution of 49% hydrofluoric acid, alcohol and 30% hydrogen peroxide solution (10:6:50) without stirring. In sixty five minutes, the porous Si substrate was completely removed by selective etching with the monocrystalline Si layer acting as an etch stopper, only the non-porous Si layer being left behind without etching. The etching rate of the non-porous monocrystalline Si in such etching solution was so low that the etching layer reached only a maximum of 50 Å in sixty five minutes, with the selection ratio of the etching rate of the non-porous monocrystalline Si to that of the porous layer being $1:10^5$ or more, so that the amount of non-porous layer which was etched (several tens angstroms) could be ignored in the practical operation. Thus, the 200-micron thick porous Si substrate was removed, with a result that the 1.0 μm thick monocrystalline Si layer was formed on SiO_2. When SiH_2Cl_2 was used as the source gas, the growth temperature had to be higher by several tens of degrees. However, high-speed etching characteristic to the porous substrate was maintained.

A field effect transistor was fabricated on the above-mentioned monocrystalline Si thin film and connected to creat complementary elements and its integrated circuit, thereby forming pixel switching elements and a drive circuit necessary for the liquid crystal image display. Note that the method of fabricating each transistor relied on one of the well-known MOS integrated circuit fabrication techniques.

Also, the opposite substrate **2** was fabricated in the following way.

A chromium dioxide film was formed as the black matrix on a low alkali glass substrate of low thermal expansion by sputtering, and shaped into a predetermined pattern by photo-etching. Then, each filter of red, blue and green was formed by pigment dispersing, a top coat layer was provided thereon, and further an ITO layer was formed by sputtering.

Embodiment 2

A liquid crystal panel was fabricated in the same way as in the embodiment 1, except that a bank **9** was provided on the opening portion **5** of the dummy seal **4** as shown in FIG. **3**.

Because a sealant for the opening portion **5**, even though being low viscous, can be dammed by the bank **9**, according to this embodiment, the sealant can be prevented from flowing within the dummy seal **4** owing to surface tension to seal off liquid crystal inlets **10** of individual panels **3**. Accordingly, using a dummy seal **4** of this shape, the usable range of viscosity of sealant for the dummy seal **4** can be extended.

Note that the shape of bank is not limited to that as shown in FIG. **3**, but a variety of shapes such as "]" may be used.

Embodiment 3

A polycrystalline silicone was formed on a quartz glass as the TFT substrate, and a field effect transistor was created on the polycrystalline silicone thin film, and connected to creat complementary elements and its integrated circuit, thereby forming pixel switching elements and a drive circuit necessary for the liquid crystal image display.

A chromium dioxide film was first formed as the black matrix on a quartz glass substrate as the opposite substrate by sputtering, and shaped into a predeter-

mined pattern by photo-etching. Then, each filter of red, blue and green was formed by a dyeing method, a top coat layer was provided thereon, and further an ITO layer was formed by sputtering. FIG. 4 shows schematically a shape of the dummy seal in this embodiment.

While the quartz glass was of a square shape in this embodiment, it may be formed in the same shape as the wafer.

As above described, since the dummy seal is provided with an opening portion according to the present invention, a desired cell gap can be obtained without enclosing the air between substrates, whereby a liquid crystal panel which can make excellent display can be fabricated. Further, the variation in the cell gap due to expansion of the air on heat curing of the sealant can be prevented. Accordingly, a reliable liquid crystal panel can be fabricated without restrictions on the temperature condition for the heat curing. And since the opening portion of dummy seal is sealed off before dicing, the invasion of the cooling water into the liquid crystal panel can be prevented.

What is claimed is:

1. A method of fabricating a liquid crystal panel by bonding TFT substrate, on which plural TFTs are formed with an opposing substrate, and then dividing the substrates into each of display panels, comprising steps of:

forming a dummy seal having an opening at least in part thereof, said dummy seal being located at a peripheral area around at least 2 liquid crystal panels and not being located at the display panel area on at least one of said TFT substrate and the opposing substrate;

bonding said TFT substrate with said opposing substrate;

hardening said dummy seal;

sealing the opening of said hardened dummy seal; and

dividing said substrates into display panels.

2. The method of fabricating the liquid crystal panel according to claim 1, wherein one of the substrates comprises an Si wafer.

3. The method of fabricating the liquid crystal panel according to claim 2, further comprising the step of producing said Si wafer by making porous a monocrystalline Si substrate and thereafter forming an epitaxial layer on said porous substrate layer.

4. The method of fabricating the liquid crystal panel according to claim 1, further comprising the step of selecting an adhesive as a sealant for sealing said opening.

5. The method of fabricating a liquid crystal panel according to any of claims 1–4, wherein said dummy seal is a thermally hardening resin.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,410,423
DATED : April 25, 1995
INVENTOR(S) : TERUHIKO FURUSHIMA, ET AL

It is certified that error appears in the above-indentified patent and that said Letters Patent is hereby corrected as shown below:

ON TITLE PAGE

In [56] References Cited, under U.S. PATENT DOCUMENTS:
"4,255,848 3/1981 Frees et al." should read
--4,255,848 3/1981 Freer et al.--;
"5,206,749 4/1993 Zavrachy et al." should read
--5,206,749 4/1993 Zavracky et al.--.

In [56] References Cited, under FOREIGN PATENT DOCUMENTS:
"298219 6/1988 Japan" should be deleted;
"03298219 12/1988 Japan" should read
--63-298219 12/1988 Japan--; and
"4338926 11/1992 Japan" should read
--4-338926 11/1992 Japan.--.

Signed and Sealed this
Eighth Day of August, 1995

Bruce Lehman

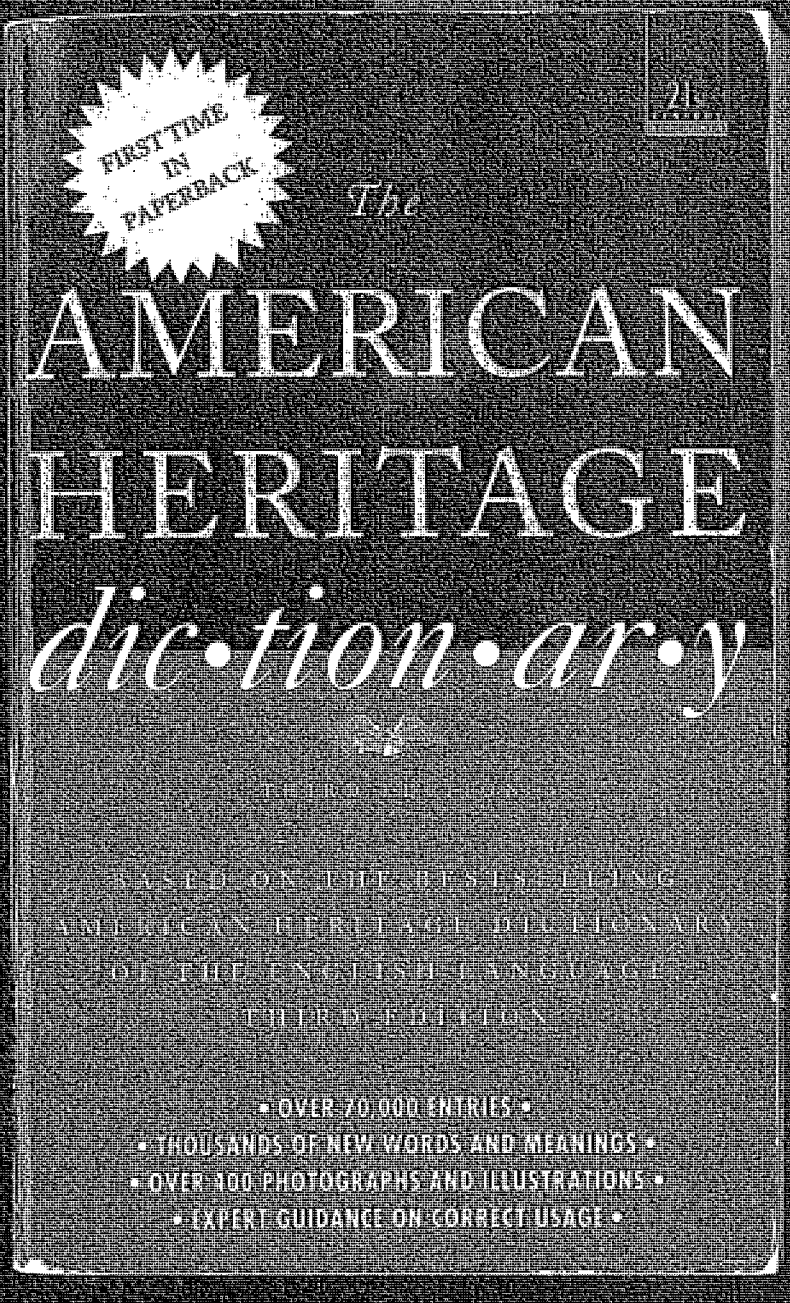
Attest:

Attesting Officer

BRUCE LEHMAN

Commissioner of Patents and Trademarks

Exhibit 4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10

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se•quel (sē′kwəl) *n.* 1. Something that follows; continuation. 2. A literary work that continues an earlier narrative. 3. A consequence. [< Lat. *sequēla.*]

se•quence (sē′kwəns, -kwĕns′) *n.* 1. A following of one thing after another; succession. 2. An order of succession; arrangement. 3. A related or continuous series. [< Lat. *sequēns,* following.] —**se′•quence** *v.* —**se•quen′tial** (sĭ-kwĕn′shəl) *adj.* —**se•quen′tial•ly** *adv.*

se•ques•ter (sĭ-kwĕs′tər) *v.* 1. To cause to withdraw into seclusion. 2. To set apart; segregate. See Syns at *isolate.* 3. *Law.* To confiscate (property) as security against legal claims. [< Lat., depositary.] —**se′ques•tra′tion** *n.*

se•quin (sē′kwĭn) *n.* A small shiny ornamental disk, usu. sewn on cloth; spangle. [< Ital. *zecchino,* a Venetian coin.] —**se′quined** *adj.*

se•quoi•a (sĭ-kwoi′ə) *n.* See redwood 1. [After Sequoya.]

Se•quoy•a or **Se•quoy•ah** (sĭ-kwoi′ə), 1770?–1843. Cherokee scholar.

Sequoya

se•ra (sîr′ə) *n.* A pl. of serum.

se•ra•glio (sə-räl′yō, -räl′-) *n., pl.* -glios. 1. A harem. 2. A sultan's palace. [Ital. *serraglio.*]

se•ra•pe also **sa•ra•pe** (sə-rä′pē, -räp′ē) *n.* A long blanketlike shawl worn esp. by Mexican men. [Am.Sp. *sarape.*]

ser•aph (sĕr′əf) *n., pl.* -a•phim (-ə-fĭm) or -aphs. *Theol.* An angel of the highest order. [< Heb. *sārāp.*] —**se•raph′ic** (sə-răf′ĭk), **se•raph′i•cal** *adj.*

Serb (sûrb) *n.* A member of a southern Slavic people that is the principal ethnic group of Serbia.

Ser•bi•a (sûr′bē-ə). A region and former kingdom of the Balkan Peninsula. With Montenegro it established a new Yugoslavian nation in Apr. 1992.

Ser•bi•an (sûr′bē-ən) *n.* 1. A native or inhabitant of Serbia. 2. Serbo-Croatian as used by the Serbs. —**Ser′bi•an** *adj.*

Ser•bo-Cro•a•tian (sûr′bō-krō-ā′shən) *n.* 1. The Slavic language of the Serbs, Croats and other people. 2. A native speaker of Serbo-Croatian. —**Ser′bo-Cro•a′tian** *adj.*

sere also **sear** (sîr) *adj.* Withered; dry. [< OE *sēar.*]

ser•e•nade (sĕr′ə-nād′, sĕr′ə-nād′) *n.* A musical performance given to honor or express love for someone. —*v.* -nad•ed, -nad•ing. To perform a serenade (for). [< Ital. *serenata.*] —**ser′e•nad′er** *n.*

ser•en•dip•i•ty (sĕr′ən-dĭp′ĭ-tē) *n.* The faculty of making fortunate discoveries by accident. [After the Persian fairy tale *The Three Princes of Serendip.*] —**ser′en•dip′i•tous** *adj.* —**ser′en•dip′i•tous•ly** *adv.*

se•rene (sə-rēn′) *adj.* 1. Calm and unruffled; tranquil. 2. Unclouded; fair. [< Lat. *serēnus.*] —**se•rene′ly** *adv.* —**se•rene′ness, se•ren′i•ty** (-rĕn′ĭ-tē) *n.*

serf (sûrf) *n.* 1. A member of a feudal class of people in Europe, bound to the land and owned by a lord. 2. A slave. [< Lat. *servus,* slave.] —**serf′dom** *n.*

serge (sûrj) *n.* A twilled cloth of worsted or worsted and wool. [< Lat. *sērica,* silken.]

ser•geant (sär′jənt) *n.* 1. Any of several ranks of noncommissioned officers, as in the U.S. Army. 2. A police officer ranking next below a captain, lieutenant, or inspector. [< LLat. *servīēns,* public official.]

sergeant at arms *n., pl.* sergeants at arms. An officer appointed to keep order within an organization, such as a legislature.

sergeant first class *n., pl.* sergeants first class. A rank in the U.S. Army below master sergeant.

sergeant major *n., pl.* sergeants major or sergeant majors. 1. Any of the highest noncommissioned ranks in the U.S. Army and Marine Corps. 2. *Chiefly Brit.* A noncommissioned officer of the highest rank.

se•ri•al (sîr′ē-əl) *adj.* 1. Of, forming, or arranged in a series. 2. Published or produced in installments. —*n.* A work published or produced in installments. —**se′ri•al•i•za′tion** *n.* —**se′ri•al•ize′** *v.* —**se′ri•al•ly** *adv.*

se•ries (sîr′ēz) *n., pl.* series. 1. A number of objects or events arranged one after the other in succession; set. 2. A succession of regularly aired radio or television programs. 3. *Sports.* A number of games played in succession by the same opposing teams. [Lat. *seriēs* < *serere,* join.]

Usage: When *series* has the singular sense of "one set," it takes a singular verb, even when followed by *of* and a plural noun: *A series of lectures is scheduled.* When *series* has the plural sense of "one or more sets," it takes a plural verb: *Two series of lectures are scheduled.*

ser•if (sĕr′ĭf) *n. Print.* A fine line finishing off the main strokes of a letter. [Perh. < Du. *schreef,* line.]

se•ri•o•com•ic (sîr′ē-ō-kŏm′ĭk) *adj.* Both serious and comic.

se•ri•ous (sîr′ē-əs) *adj.* 1. Grave in quality or manner. 2. Carried out in earnest. 3. Concerned with important rather than trivial matters. 4. Causing great concern; critical. [< LLat. *sēriōsus.*] —**se′ri•ous•ly** *adv.* —**se′ri•ous•ness** *n.*

ser•mon (sûr′mən) *n.* 1. A homily delivered as part of a liturgy. 2. A lengthy and tedious reproof or exhortation. [< Lat. *sermō,* discourse.] —**ser′mon•ize′** *v.* —**ser′mon•iz′er** *n.*

se•rol•o•gy (sĭ-rŏl′ə-jē) *n.* The medical study of serum. —**se′ro•log′ic** (sîr′ə-lŏj′ĭk), **se′ro•log′i•cal** *adj.* —**se•rol′o•gist** *n.*

se•ro•neg•a•tive (sîr′ō-nĕg′ə-tĭv) *adj.* Showing a negative reaction to a test on blood serum for a disease, esp. syphilis or AIDS.

se•ro•pos•i•tive (sîr′ō-pŏz′ĭ-tĭv) *adj.*